DOCUMENT RESUME

ED 112 750 HE 006 734

AUTHOR Lawrence, Ben
TITLE Techniques in the Use of Systems and Budgeting Methodology: A Conceptual Overview.
INSTITUTION National Association of Coll. and Univ. Business Officers, Washington, D.C.
PUB DATE Aug 72
NOTE 5p.
AVAILABLE FROM National Association of College and University Business Officers, One Dupont Circle, Washington, D.C. 20036
JOURNAL CIT Studies in Management; v2 n1 Aug 1972

EDRS PRICE MF-$0.76 Plus Postage. HC Not Available from EDRS.
DESCRIPTORS Accountability; *Budgeting; Cost Effectiveness; *Decision Making; *Educational Finance; Estimated Costs; Financial Policy; *Higher Education; Input Output Analysis; Program Costs; Program Planning; School Planning; Systems Analysis; *Systems Approach; Unit Costs
IDENTIFIERS *Program Classification Structure

ABSTRACT

Program budgeting is described as a means of enabling higher education to respond effectively to three major accountability concerns. They are (1) the long-term financial implications of a particular programmatic or policy decision, (2) determination of what is being paid for, and (3) understanding that the price being paid for a program is reasonable. A Program Classification Structure (PCS) is described which facilitates the concepts of program budgeting. PCS provides cost centers for the preliminary and support activities of an institution. If an institution determines the cost of instruction in each discipline, degree program costs may be obtained by allowing the dollars to flow from the discipline cost centers to the various degree program cost centers in proportion to the flow of credit hours from disciplines to degree programs. Program output indicators and information exchange procedures are also used, as are student flow models that project enrollments by major and by student level within the institution. Using a program budget, decision makers can compare the costs of various alternatives and weigh these costs against their anticipated benefits. (LBH)

# TECHNIQUES IN THE USE OF SYSTEMS AND BUDGETING METHODOLOGY: A CONCEPTUAL OVERVIEW

By Ben Lawrence

*The paper that follows was delivered by Dr. Lawrence on July 11 at the 1972 NACUBO Annual Meeting at the Denver Hilton in Denver.*

SYSTEMS, though not acknowledged until recently, have been employed by budgeters for many years. Today, however, we are concerned with the newer systems techniques and the new concepts of systems analysis related to budgeting in higher education.

First, it is necessary to state for the record that the practical utility of the new management systems concepts has yet to be established. It is true that we have some theoretical understanding of what they can do for us. It is also true that sufficient pilot testing and pragmatic applications indicate that these concepts hold significant promise of utility. But there has not been, as yet, a significant, widespread application of management systems concepts from which we can draw the conclusion that they are useful.

Second, we may reasonably expect a significant, widespread application of these concepts in the next two years and conclusive evidence of their utility. For purposes of this discussion, however, we are concerned with the potential or probable usefulness of these concepts as opposed to their proven usefulness.

A commonly used umbrella term to cover all the new conceptual approaches to systematic budgeting is "program budgeting." While advocates of program budgeting push different approaches and claim many virtues, this particular concept holds the promise of enabling higher education to respond effectively to three major accountability concerns:

1) *What are the long-term financial implications of a particular programmatic or policy decision?* Program budgeting concepts generally attempt to array programmatic and financial information in a way that indicates the long-term consequences of a particular budgeting decision. For example, if we add a new department this year at level of operation X and at a cost of Y dollars, what is the projected level of operation and anticipated costs three years hence?

Or, if I employ twenty new faculty this year at an increase in the salary budget of X dollars, what is likely to be the dollar effect on the salary budget five years hence?

Or, conversely (if I am trying to reduce budgeting size), if I reduce or eliminate program X this year, what will be the overall effect on my budget for each of the next several years?

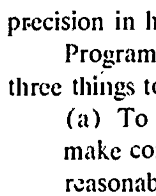
2) *How can we get an understanding of what we are paying for?* The activities and products of higher education are so numerous as to be bewildering to the person attempting to understand it. Program budgeting concepts generally try to develop programmatic structures that permit the aggregation of small activities into larger homogeneous programs aimed at the stated objectives of the institution. The purpose of this aggregation is to communicate quickly what dollars are being used for in a program sense, as opposed to a resource sense.

3) *How do we know that the price we are paying for that program is reasonable? Could the same program be produced for less money?* This concern is at the same time more prevalent and more vexing than the other two combined, for "worth" is something that almost everyone is interested in, yet it is extremely difficult to establish with precision in higher education.

Program budgeting concepts generally attempt to do three things to assist in evaluating worth:

(a) To produce compatible unit cost information to make comparisons of specific products and their costs reasonable as well as possible.

(b) To relate resources used to program outputs so that alternate use of the resources may be considered to produce either the same outputs at less total cost or more preferred outputs at the same cost.

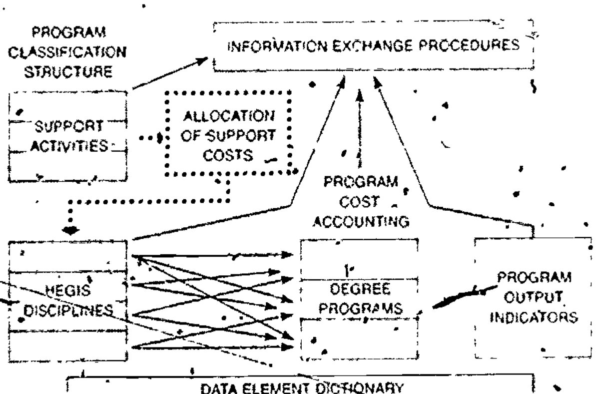


**Ben Lawrence** *is an Associate Director of the Western Interstate Commission for Higher Education and Director of the National Center for Higher Education Management Systems at WICHE. Dr. Lawrence received his B.A. from Whitman College, a Diploma in Education from the University of London, and M.Ed and Ph.D. degrees from the University of Oregon.*

(c) To undertake cost-benefit analysis, that is, an example of the worth of the output produced not only related to its costs to produce, but also related to its worth or utility to the purchaser after production. A bachelor's degree in history may cost $10,000 to produce. Is a bachelor's degree in history worth that, or less, or more? If it is worth what it costs or more, then presumably it will generate sufficient productivity to put back into the system the cost of the original investment plus interest and inflation. If it is not worth what it cost, then the original investment will eventually be eroded and the production process will face bankruptcy.

FIGURE 1

SELECTION OF PMS TOOLS
TO GATHER HISTORICAL INFORMATION




While program budgeting concepts—one portion of planning, programming and budgeting systems—are certainly systems concepts, more detailed systems techniques are needed if these concepts are to become operational. It is easy to talk about unit costs for comparison, but it is much more difficult to produce them. The NCHEMS Program Classification Structure is specifically designed to facilitate the concepts of program budgeting as previously outlined.

The new systems tools and techniques fall into two general categories: 1) those that are used to gather historical data, and 2) those that use the historical data as a point of departure to project future costs and assist in making judgments about alternate future operations. *Figure 1* displays some of the tools concerned with data collection.

## The New Planning and Management Systems

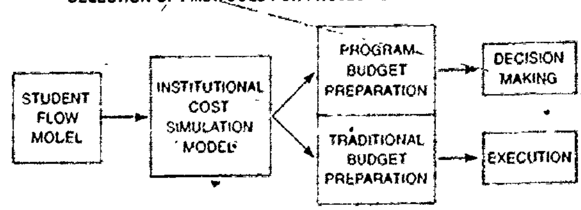
The PCS provides cost centers for the preliminary and support activities of an institution. It may be viewed as a common filing structure to which various kinds of data may be attached. The PCS cost centers in the instructional area consist of a list of disciplines that correspond to the reporting categories required by the Higher Education General Information Survey (HEGIS). Institutional data may be translated into the NCHEMS PCS in preparation for reporting to the USOE through HEGIS.

If an institution determines the cost of instruction in each discipline, degree program costs may be obtained by allowing the dollars to flow from the discipline cost centers to the various degree program cost centers in proportion to the flow of credit hours from disciplines to degree programs. For example, the history discipline costs would flow proportionally to each degree program as students from the various degree programs take credits in the history discipline. If support costs were previously allocated to the disciplines, these costs would also flow to the degree program cost centers along with the direct instructional costs and would be calculated as part of the total cost of each degree program.

Two additional areas of concern are program output indicators and information exchange procedures. If cost-benefit analysis is to be applied to an institution, good program output indicators are necessary. Likewise, costing and output studies must be performed under precisely the same set of procedures if information exchange is to have any validity. Both of these areas are receiving a great deal of attention and will continue to be researched over the next few years.

Once an institution knows its current program costs and outputs, it has a base on which to plan for future operations. (See *Figure 2*.) Various alternative plans can be developed that will lead the institution toward its objectives. Student flow models and resource requirements prediction models can be very helpful at this point in evaluating various plans and in predicting the long-range resource requirements that are being committed by current decisions.

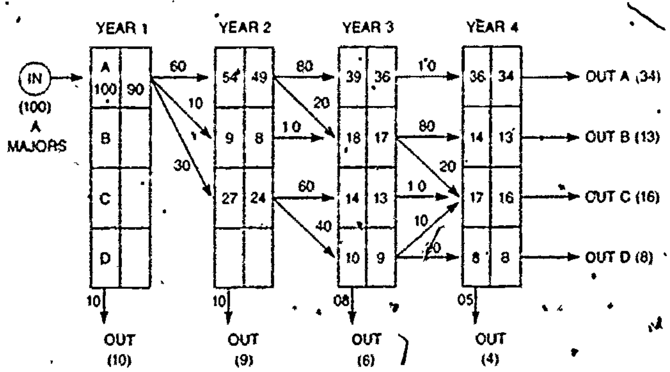
SELECTION OF PMS TOOLS FOR PROJECTION AND PLANNING




Student flow models may be used to project student enrollments by major and by student level within the institution. This is valuable information that serves as a principal input to a resource requirements prediction model. NCHEMS resource requirements prediction models use student enrollments and planning parameters related to faculty, classes, support staff, supplies and equipment, etc., to forecast in a program budget format the resources required when the institution is operated in accordance with a variety of alternative plans.

Using a program budget, decision makers can compare the costs of various alternatives and weigh these costs against their anticipated benefits. In addition, PMS tools may be used to generate a traditional budget that will show the flow of resources to various departments as required to implement a desired set of programs. Thus, PMS tools are able to generate program budgets for program decision making and traditional line-item budgets for program execution.

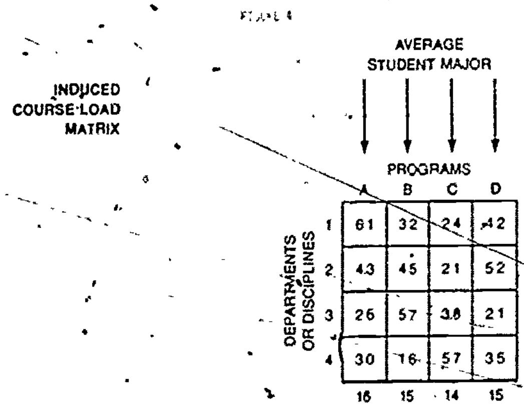
FIGURE 3
STUDENT FLOW FOR TYPE A MAJORS




A student flow model may take different forms. The NCHEMS model uses transitional probabilities to forecast the flow of students between majors from one year to the next. In *Figure 3*, one hundred type A majors enter the institution in Year One. During Year One, ten percent leave the institution. Of those students who remain, sixty percent continue as type A majors in Year Two; ten percent switch to type B majors; and thirty percent switch to type C. This same cycle repeats itself through Year Four, producing, in this example, thirty-four type A graduates; thirteen type B graduates; sixteen type C graduates; and eight type D graduates.

Obviously, good predictions from this model are dependent on valid and reliable transition probabilities. Tests have been completed that demonstrate the advantage of this approach in forecasting student flow. NCHEMS, in cooperation with pilot institutions, is researching various methods of developing and using student flow models.

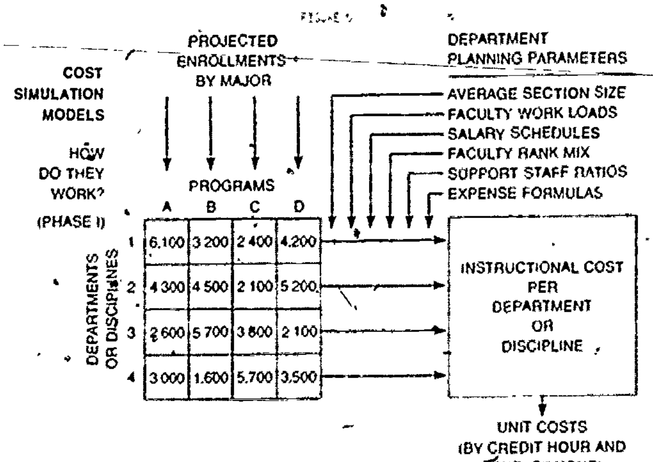
FIGURE 4




A great advantage of the type of student flow model shown above is its flexibility. The flow of various student categories (male, female, minority) may be examined individually. The attrition rates of different majors may be compared. The effect of changing admission policies related to certain types of students can be examined and analyzed. Through the use of a student flow model, the educator can understand better what is happening to different groups of students as they pass through his institution. This improved understanding can lead to efforts to shape the institution to offer the best possible service to various categories of students.

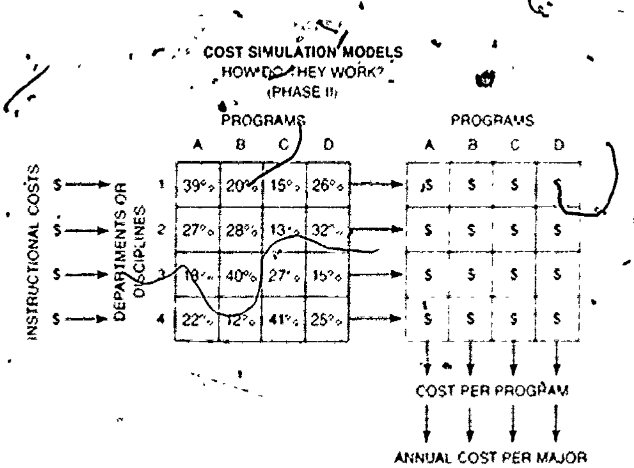
One of the foundation blocks of a resource requirements prediction model is an Induced Course Load Matrix (ICLM). This matrix displays the load induced in each discipline or department by an average major of each type. The Induced Course Load Matrix displayed in *Figure 4* shows the number of credit hours in each discipline or department taken by the average student enrolled in each of the degree programs of the institution. For example, the average type A major can be expected to take 6.1 credit hours in Discipline One, 4.3 credit hours in Discipline Two, 2.6 credit hours in Discipline Three, and 3.0 credit hours in Discipline Four. If one hundred type A majors are admitted to the institution, it can be readily ascertained that the load induced on Discipline One will be 610 credit hours; the resulting load in Discipline Two will be 430 credit hours, and so forth. Thus, any given set of enrollment projections may be multiplied down through the Induced Course Load Matrix to determine the total estimated credit hour load that will be demanded of each of the disciplines or departments in the institution.

FIGURE 5




When the projected enrollments have been multiplied through the Induced Course Load Matrix, the predicted credit hour demand in each discipline or department induced by each type of major is known. (See *Figure 5*.) Summing across the matrix containing the credit hour loads induced by each type of major gives the total credit hours that a department must produce. Various planning parameters may then be used to describe how each department's instructional function will be operated. Parameters such as average section size, faculty work load, salary schedules, support staff ratios, and expense formulas have substantial resource implications. Once the department planning parameters are established and the student enrollments are known, the projected department costs are calculated. The cost per credit hour may then be derived by dividing the total instructional cost of each department by the total credit hours to be produced. Cost comparisons between departments are very difficult, at best, because of different departmental roles and missions, however, if cost comparisons are desired, they are most appropriately made using cost per credit hour (or contact hour), since this eliminates the effect of size difference between departments.

Having determined the instructional cost for each department, a resource requirements prediction model will proceed to distribute those department costs to the various degree programs in direct proportion to the number of credit hours drawn from each department by each degree program. The workload induced in a given department by majors in a specific type of program represents a percentage of the total workload of that department, as shown in *Figure 6*. If the percentages for each department are added horizontally, they will equal one hundred percent. Each percentage will represent a degree program's contribution to the total workload of a particular department. The instructional costs of each department may be distributed across the various programs in accordance with the derived percentages and placed in another matrix. The cost of each degree program is calculated by summing all the dollars in a column of this final matrix. Thus, the cost of the degree program A is obtained by summing all the dollars in column A. The annual cost per major is a useful unit for comparing degree program costs and is obtained by dividing the total cost of a degree program by the number of majors.




This entire view of resource requirements prediction models can be expanded from two dimensions to four dimensions. The expanded model handles student levels within degree programs (lower division, upper division, and graduate), and different instruction levels (lower division, upper division, and graduate). Such an expanded model provides costs for each discipline at different levels of instruction and for each degree program at different levels of student major.

A program budget can be constructed in a variety of formats; however, there are certain kinds of information that will almost always be included. *Figure 7* displays the direct instructional costs for the history degree program at lower division, upper division, and graduate levels. The total direct instructional cost is a result of the annual cost per major and the anticipated number of majors. If these numbers are accurate, the total direct cost is an inevitable consequence. Thus, any negotiation or justification pertaining to a program budget must center on the number of students to be admitted and the annual cost per major.

FIGURE 7

WHAT DOES A PROGRAM BUDGET LOOK LIKE?

| INSTRUCTIONAL PROGRAMS | ANTICIPATED NUMBER OF STUDENT MAJORS | ANNUAL COST PER MAJOR | TOTAL DIRECT INSTRUCTIONAL COSTS |
|---|---|---|---|
| HISTORY | | | |
| LOWER DIVISION | 228 | $ 873 | $199 044 |
| UPPER DIVISION | 186 | 1 096 | 203 856 |
| GRADUATE | 91 | 1 309 | 119,119 |
| | | | $522 019 |

| DEPARTMENT PLANNING PARAMETER INFORMATION | |
|---|---|
| AVERAGE SECTION SIZE | FACULTY PRODUCTIVITY RATIOS |
| FACULTY WORK LOADS | SALARY AND WAGE SCHEDULES |
| | MIX OF FACULTY RANKS |
| | RATIO OF SUPPORT STAFF TO FACULTY |
| | EXPENSE FORMULAS |

The number of students may be set by policy, or if not limited, predicted by a student flow model. The annual cost per major is a consequence of planning parameter decisions (displayed as back-up information in a program budget). Once it is determined what the average section size, faculty work load, salary schedule, expense formulas, etc., will be, and the number of students is known, the annual cost per major and total cost of each degree program are calculated by means of a resource requirements prediction model. When the costs used to prepare a program budget are deemed reasonable and valid, yet not enough funds are available for all desirable programs, institutional priorities must be established. The anticipated outputs or benefits of the various programs must be compared and weighed against costs in order to establish which programs will be diminished or nourished.

A program budget is not a panacea. It cannot be expected to make decision making easier. Rather, it displays resource requirements in relation to output-generating programs and provides greater insight into what we are buying with our educational expenditures.

Output accounting is an essential complement to program accounting and program budgeting. The Research and Development Unit at NCHEMS is currently exploring the area of output accounting. An attempt is being made to establish a list of variables (related to instruction, research, community service, and the institutional environment) which, if measured, would provide a comprehensive profile of the institution and its outcomes. Only through trying a wide variety of approaches in pilot institutions will we be able to increase our understanding of what is possible, feasible, and desirable insofar as institutional output accounting is concerned. In this area, it is certainly true that progress will come slowly and in small increments.